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INTERIM REMOVAL ACTION TECHNOLOGY EVALUATION FIELD SAMPLING PLAN FOR OPERABLE UNIT 3 (OU 3) NAS JACKSONVILLE FL
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ABB ENVIRONMENTAL

INTERIM REMOVAL ACTION TECHNOLOGY EVALUATION FIELD SAMPLING AND ANALYSIS PLAN (FSAP)

BUILDINGS 106 AND 780 AT OPERABLE UNIT 3

NAVAL AIR STATION JACKSONVILLE
JACKSONVILLE, FLORIDA

Unit Identification Code (UIC): N00207

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
bls	below land surface
CLEAN	Comprehensive Long-term Environmental Action, Navy
COC	chain of custody
CompQAP	Comprehensive Quality Assurance Plan
CPCs	chemicals of potential concern
°C	degrees Celsius
°F	degrees Fahrenheit
DOT	Department of Transportation
EE/CA	Engineering Evaluation/Cost Analysis
FSAP	Field Sampling and Analysis Plan
g	grams
GC	gas chromatograph
GE/AI	Groundwater Extraction and Air Injection
gpm	gallons per minute
HASP	Health and Safety Plan
HDPE	high-density polyethylene
HP	horsepower
IDW	investigation-derived wastes
IRA	interim removal action
mℓ	milliliter
mg/ℓ	microgram per liter
μg/ℓ	microgram per liter
NAS	Naval Air Station
NEESA	Naval Energy and Environmental Support Activity
NIRP	Navy Installation Restoration Program
OU	Operable Unit
PCP	Performance Criteria Package
PPE	personal protective equipment
psi	pounds per square inch
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAC	Remedial Action Contractor
RI/FS	Remedial Investigation and Feasibility Study
SCFM	standard cubic feet per minute

USEPA	U.S. Environmental Protection Agency
VE	vapor extraction
VO	vapor observation
VOC	volatile organic compound

1.0 INTRODUCTION

This Field Sampling and Analysis Plan (FSAP), prepared by ABB Environmental Services, Inc. (ABB-ES), describes the procedures for collecting samples and performing field tests at Buildings 106 and 780 at Naval Air Station (NAS) Jacksonville Operable Unit (OU) 3.

In accordance with the *Plan of Action, Interim Removal Action, Buildings 106 and 780* (ABB-ES, 1994b), field sampling and testing is required to evaluate remedial technologies that can potentially remove chlorinated volatile organic compounds (VOCs) from OU 3. The field program described in this FSAP will be performed to collect the required data. The results of the field program will be used to perform an Engineering Evaluation and Cost Analysis (EE/CA). If an effective Interim Removal Action (IRA) is identified, an action memorandum and a Performance Criteria Package (PCP) will be prepared by ABB-ES for implementation by the Navy's Remedial Action Contractor (RAC).

This FSAP is a guide for field personnel to perform the required field program. As required for the Comprehensive Long-Term Environmental Action, Navy (CLEAN) program, the procedures described in this FSAP follow the general guidelines of the following documents:

- *Navy Installation Restoration Program Plan (NIRP), Naval Air Station, Jacksonville, Florida, Volume I, Organization and Planning* (Geraghty & Miller, 1991a);
- *Navy Installation Restoration Program Plan (NIRP), Naval Air Station, Jacksonville, Florida, Volume 4, The Basic Site Work Plan* (Geraghty & Miller, 1991a);
- *Standard Operating Procedures, Comprehensive Long-Term Environmental Action, Navy (CLEAN) Program* (ABB-ES, 1994c);
- *Comprehensive Quality Assurance Plan (CompQAP), Florida Operations and CLEAN Operations* (ABB-ES, 1993); and
- *Environmental Compliance Branch, Standard Operating Procedures and Quality Assurance Manual, USEPA Region IV* (U.S. Environmental Protection Agency [USEPA], 1991).

1.1 OBJECTIVES. The primary objective of the field program is to collect data required to evaluate the effectiveness of the following technologies:

- biodegradation,
- groundwater pumping,
- vapor extraction, and
- air injection.

These technologies were identified while scoping the Remedial Investigation and Feasibility Study (RI/FS) field program for OU 3 and are discussed in Chapters 4.0 and 8.0 of the RI/FS workplan (April 1994). Technologies that are proven effective will be combined into an IRA.

1.2 BACKGROUND INFORMATION. The location of NAS Jacksonville is presented in Figure 1-1, the location of OU 3 is presented in Figure 1-2, and the boundaries that define OU 3 are presented in Figure 1-3.

The history and results of investigations conducted at OU 3 are contained in Section 2.2, Section 2.3, and Appendix B of the RI/FS workplan. Based on these prior investigations, preliminary chemicals of potential concern (CPCs) were identified. Of these preliminary CPCs, chlorinated VOCs appear to be the most prevalent. Because chlorinated VOCs do not occur naturally they are likely to be retained as CPCs for OU 3. These chlorinated VOCs may be the result of products used at OU 3, impurities in products used, or degradation products of parent compounds.

Rather than await the completion of the OU-wide RI/FS before removing "hot spots" of chlorinated VOCs, an IRA was proposed to expedite their removal. As previously discussed, this field program is the first step in selecting and implementing an appropriate IRA.

Because the highest concentrations of chlorinated VOCs were detected at Buildings 106 and 780, these two areas were selected for further study. The Building 106 and 780 study areas are shown on Figures 1-4 and 1-5, respectively.

2.0 FIELD PROCEDURES

2.1 GENERAL PROJECT SCOPE. Table 2-1 summarizes the field program. Field work will be performed in the order presented in the table. A detailed schedule for the field program is presented in Figure 2-1.

A Health and Safety Plan (HASP) has been prepared to describe the general procedures required to safely execute the field program. The Buildings 106 and 780 study areas will be monitored by ABB-ES with the equipment identified in this chapter. Based on results of previous studies at OU 3, Level D personal protective equipment (PPE) will be used. If conditions require a PPE upgrade (to Level C or greater) field activities will be stopped until field personnel upgrade their PPE accordingly.

2.2 GENERAL PROCEDURES. General procedures for the field program are presented in this section. These procedures include:

- documentation of field activities,
- sample and well designation,
- sample custody and shipping,
- field instrument calibration,
- field decontamination procedures,
- location clearance, and
- pavement coring and repair.

2.2.1 Documentation of Field Activities The conditions, work progress, and activities performed during the field program will be documented by ABB-ES personnel in field logbooks, by photography, and on field forms.

2.2.1.1 **Field Logbook** The field team will maintain a field logbook. The field logbook is the master field investigation document. Its primary purpose is to record field data and to reference other field documents that contain specific descriptions of each activity that occurs during the field program. The cover of the logbook will list the project number and name, the contract under which the investigation is being conducted, and the dates of use. The front of the logbook will indicate the ownership of the book (ABB-ES), and include the business address and phone number. (A business card taped inside the front cover could be used to document this information.) The logbook will also list the names, addresses, and telephone numbers of subcontractors, Navy contacts, and emergency contacts.

General Notes

- The field logbook will be a glued or sewn bound book with a hard cover. Ring binders or similar binding types are not acceptable.

- The pages will be numbered sequentially in the logbook.

- All entries will be in permanent black ink and handwriting will be legible.

Table 2-1
Summary of Field Program Activities

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
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NAS Jacksonville, Jacksonville, Florida

Activity	Description
Mobilization and Demobilization	One field mobilization and one field demobilization - General field program start-up and shut-down activities
Soil Gas Survey	Two study areas - 50 points at Building 106 - 40 points at Building 780
Saturated Soil Sampling	Four saturated soil samples (two from each GE/AI Well) - two samples from GE/AI well at Building 106 - two samples from GE/AI well at Building 780
Well, Piezometer, and Probe Installation	2 GE/AI wells, 2 VE wells, 8 piezometers, and 10 VO probes - one GE/AI well at Building 106 - one VE well at Building 106 - four piezometers at Building 106 - five VO probes at Building 106 - one GE/AI well at Building 780 - one VE well at Building 780 - four piezometers at Building 780 - five VO probes at Building 780
Groundwater Sampling	Two groundwater samples (one from each GE/AI well) - one sample from GE/AI well at Building 106 - one sample from GE/AI well at Building 780
Groundwater Pumping Test	Two pumping tests - one test using the GE/AI well at Building 106 - one test using the GE/AI well at Building 780
Vapor Extraction Test	Two vapor extraction tests - one test using the VE well at Building 106 - one test using the VE well at Building 780
Air Sparging Test	Two air injection tests - one test using the GE/AI well at Building 106 - one test using the GE/AI well at Building 780

Notes: GE/AI = groundwater extraction and air injection.
VE = vapor extraction.
VO = vapor observation.

- Errors will not be obliterated, but crossed out with a single line, dated, and initialed. Pages will never be removed from the logbook.

- The events in the field will be listed in chronological order whenever possible.

- The logbook will be written to clearly document what, when, where, who, why, and how field events occurred, and the significance of those events.

- Any deviation from the FSAP, HASP, or project scope of work will be explained in the field logbook. This will include decontamination procedures, sampling procedures, monitoring well installation, safety equipment, or any other equipment, methodology, or procedure specifically outlined in these documents.

- At the end of each day, the logbook user will sign at the bottom of the last page of notes.

- Any unused space in the logbook will have a single diagonal line drawn through the blank space, and will be signed and dated to prevent any notes from being added to those pages.

<u>Site Conditions</u>. The following information concerning site conditions will be entered daily:

- day, date, and time entered onsite; temperature; weather conditions; and names and titles of personnel present onsite;

- daily plan indicating the projected scope of work;

- daily summary indicating accomplishments, including quantities and billable items (e.g., feet drilled, number and nature of samples collected, decontamination time, wells installed, etc.);

- names, titles, and organizational affiliation of visitors who enter the site during the day;

- arrival and departure times of any subcontractors onsite and a general description of their chronological activities;

- sketch of the sampling sites showing pertinent structures and items (such maps will be to scale, if possible, or, at a minimum, include dimensions and references to permanent landmarks);

- equipment used and procedures performed, such as decontamination;

- specific comments relative to any problems, their resolutions, and their anticipated impact to the field program;

- instruments calibrated during the day, the individual who performed the calibration, results of the calibration, and reference to the page in the calibration log that provides more specific information; and

- record of telephone calls (incoming or outgoing) and other communications pertaining to the field program, and a reference to the page in the telephone log that provides more specific information.

Field Sampling, Testing, and Other Activities. The following activities will be addressed in the logbook as they occur.

- Activities related to performing the soil gas survey; collecting soil and groundwater samples; installing wells, piezometers, and probes; and performing field tests will be recorded. This information will include locations of sampling and testing, results of field measurements and observations, and personnel and equipment records.

- Time of drilling for each borehole will be recorded. Lithologic descriptions of the drill cuttings and samples will be recorded in the logbook. Field monitoring readings, blow counts, recovery, and comments will be recorded. A tabular format, similar to a geologic (boring) log, is an efficient way to record these data and facilitates entry into the geologic database.

- Construction details for monitoring wells and the type (e.g., size, brand name, etc.) and amount of material used to complete the borehole or the monitoring well (e.g., drilling mud, well casing, well screen, bottom plug, top cap, centralizers, filter pack, bentonite pellets, cement, well cover, posts, etc.). The quantities of billable items and a well construction diagram will be included.

- Well-volume calculations and estimates required for purging will be recorded in the logbook. If a pump is being used and the pumping rate is known, note the pumping rate and time required to purge the well. Also note any observations during purging, such as slow recharge.

- Sample collection information (e.g., time samples were collected, analytical parameters, containers, preservatives, etc.), including the name of the analytical laboratory, will be recorded. A daily table allows quick reference for this purpose. Cross-reference chain-of-custody records for detailed information.

2.2.1.2 **Photographs** Photographs are useful in documenting field activities. Information related to each photograph will be recorded in the logbook, as well as a photographic log:

- date and time of photograph,
- photographer,
- site name,
- general direction faced and a description of the picture, and
- sequential number of the photograph and the roll number.

After photographs are processed, they will be bound in a photographic log. The above information will also be recorded in the photographic log.

2.2.1.3 **Field Forms** In addition to the logbooks, the following documents will be prepared and maintained in the field.

- A three-ring binder of photocopied daily field notes will be maintained. This binder will provide backup documentation in the event that the logbook is lost. The binder will also be used by office staff for database entry.

- Sample tracking forms will be maintained for sampling activities. This tracking form will be updated as samples are collected. It is intended as a summary to document progress and as a guide for the field staff to maintain current sampling records.

- A field instrument calibration and quality assurance record will be updated daily for field equipment used onsite.

- All samples transported offsite will be documented by chain-of-custody forms.

- All groundwater sampling will be documented by a groundwater sample record for each well.

2.2.2 Sample and Well Designation Sample identification will be consistent with the system previously used at NAS Jacksonville. The system will provide descriptive identifications for every sample and will use a standard sequence of codes to allow database entry.

2.2.2.1 Sample Identification System The sample identification number will consist of 8 or 10 characters. The following codes will compose a sample identification number: site identification, sample matrix, sample location, sample sequence (depth), and quality assurance and quality control (QA/QC) designation (if applicable). These codes are described below.

Site Identification Code. This code for all samples collected at OU 3 will be "OU 3."

Sample Matrix Code. This code will be two characters that describe the type of sample matrix. The following codes will be used during this field program:

SB = soil boring (subsurface soil) and
MW = monitoring well (groundwater).

Sample Location Code. This code will be a three-digit number, starting with 003, and proceeding consecutively. Sample locations codes 001 and 002 were used for soil borings collected during previous investigations.

Sample Sequence Code. This code will be a two-digit number starting with 01 and proceeding consecutively. This code will be used for soil samples collected from the same location at different sampling depths. This code will not be used for groundwater samples.

Note that duplicate soil and groundwater samples will be collected during the field program. These samples will consist of the 8- or 10-character identification number, with a sample sequence code of 51, 52, 53, etc., for soil samples and 501, 502, 503, etc., for groundwater samples.

Sample Identification Numbers for the Field Program:

OU3SB00301, Shallow soil sample from Building 106 Groundwater Extraction and Air Injection (GE/AI) well borehole;
OU3SB00302, Deeper soil sample from Building 106 GE/AI well borehole;
OU3SB00401, Shallow soil sample from Building 780 GE/AI well borehole;
OU3SB00402, Deeper soil sample from Building 780 GE/AI well borehole;
OU3SB00452, Duplicate of sample OU3SB00402;
OU3MW001, Groundwater sample from Building 106 GE/AI well;
OU3MW002, Groundwater sample from Building 780 GE/AI well; and
OU3MW501, Duplicate of sample OU3MW001.

2.2.2.2 **Well Identification System** A well identification number will consist of eight characters. The number will be used to identify new wells, piezometers, and probes. It will be consistent with the sample identification number for that location. The following codes will comprose a well identification number: site identification, installation, and location. These codes are described below.

Site Identification Code. This code for all samples collected at OU 3 will be "OU 3."

Installation Code. This code will be two characters that describe the type of well, piezometer, or probe installed:

MW, monitoring well (GE/AI);
VE, vapor extraction well;
TZ, temporary piezometer; and
VO, vapor observation probe.

Location Code. This code will be a three-digit number starting with 001 and proceeding consecutively. Note that the installation codes listed above have not previously been used at OU 3; thus, the location code sequence will start with 001.

Well Identification Numbers for the Field Program:

OU3MW001, GE/AI well at Building 106;
OU3MW002, GE/AI well at Building 780;
OU3VE001, VE well at Building 106;
OU3VE002, VE well at Building 780;
OU3TZ001 through 004, Piezometers at Building 106;
OU3TZ005 through 008, Piezometers at Building 780;
OU3VO001 through 005, Vapor observation probes at Building 106; and
OU3VO006 through 010, Vapor observation probes at Building 780.

2.2.3 Sample Custody and Shipping The possession of samples or other physical evidence will be traceable from the time they are obtained. This section describes custody procedures as they apply to field sampling personnel.

2.2.3.1 **Sample Custody** A sample or other physical evidence is in "custody" during any of the following situations:

- it is in the sampler's or a documented transferee's possession,

- it is in the sampler's or the transferee's field of view subsequent to the individual's possession,

- it was in the sampler's or a documented transferee's physical possession and was then secured to prevent tampering, and

- it is placed in a designated, secure area.

Chain-of-Custody (COC) Form. The COC form will be used to record the custody of all samples collected and transported offsite. All portions of the COC form will be completed. Portions of the COC form requiring clarification are outlined below.

- The sampling team leader will sign in the lower left signature block.

- The total number of sample containers for each sample will be listed in the appropriate column. The sum the total number of containers will be listed at the bottom of the column.

- The sampler and subsequent transferees will document the transfer of the samples in the blocks provided at the bottom of the form.

Field Custody Procedures.

- To simplify field custody, only designated field personnel will handle the samples or physical evidence before offsite transport.

- Sample containers will be closed with unbroken chain-of-custody seals.

- Shipping coolers will be transported with unbroken chain-of-custody seals.

2.2.3.2 **Shipping** Instructions for packing and shipping are as follows.

- All breakable sample containers (glass) will be protected with packing. Bubble-pack bags or strips are acceptable.

- Sample containers will be placed in sealable plastic bags.

- Multiple sample containers from the same sample location may be placed in the same plastic bag.

- Coolers used to transport samples will be of durable plastic material capable of resisting damage due to normal handling and dropping during shipping. The drain plug will be sealed with strapping tape or duct tape. A layer of bubble-pack will be placed along the bottom and sides of the cooler. The cooler will be lined with a large, heavy-duty plastic bag. The sample containers will be placed in an upright position. Small containers will be distributed to fill spaces between large containers. No direct contact between glass containers will be allowed. All sample containers from one sample location will be placed together.

- Samples will be maintained at 4 degrees Celsius (°C). Ice will be placed in 1-gallon sealable plastic bags, and five to seven sealed bags will be placed in the cooler. The bags of ice will be distributed evenly to maintain a constant temperature within the cooler.

- The completed COC and analysis request forms will be placed in a sealable plastic bag. This bag will be taped to the inside lid of the cooler. If multiple coolers are being used, the documents will be placed in one representative container.

- Two custody seals will be affixed to each cooler. The seals will be signed and dated and will span the lid and body of the cooler to prevent opening the cooler without breaking the custody seals.

2.2.4 Field Instrument Calibration All field instruments will be calibrated daily according to manufacturers' recommendations. During instrument use, instrument calibrations will be checked against a standard every 4 hours (typically, during lunch and at the end of the day). If background measurements differ from previous background measurements by more than 10 percent, the instrument will be recalibrated. Instrument calibration and maintenance will be documented in the field logbooks, as well as in calibration records. Field meters and monitoring equipment to be used during the field program included:

flame ionization detector (FID);
water level indicator;
conductivity, pH, and temperature meter;
redox potential meter;
turbidity meter;
data logger;
barometer;
rain gauge;
totalizing water flow meter;
calibrated water flow meter; and
dreager pump with tubes.

2.2.5 Field Decontamination Procedures To prevent cross contamination between samples, field equipment will be properly decontaminated prior to field mobilization, between sampling depths and locations, and during demobilization.

2.2.5.1 **Definitions** For clarification, the following definitions have been used.

- Detergent will be a non-phosphate laboratory detergent such as Alconox™ or Liquinox™.

- Acid solution will be a mixture of reagent-grade nitric acid and deionized water.

- Solvent will be undiluted, pesticide-grade isopropanol.

- Potable water will be drinking water from a municipal water supply.

- Deionized water will be potable water that has been treated by passing through a standard deionizing resin column.

- Analyte-free water will be potable water that has been treated by passing through a 0.3-submicron filter, one granular activated carbon charcoal filter, and two resin filters. All analytes of interest and all interferences in the water will be below method detection limits. This water will be used as a final rinse in decontamination, where required, and for blank preparation. Blank samples will be collected periodically to demonstrate purity and reliability of the water supply.

2.2.5.2 **Decontamination Pad** A temporary decontamination pad will be located downwind and downgradient from equipment drying or storage areas. The decontamination pad will consist of a shallow pit or tub. The pad will be lined with multiple layers of heavy-duty plastic sheeting and will be sloped to promote runoff toward a collection sump.

Washwater and rinsewater collected from the pad will be contained in 55-gallon drums. These drums will be labeled with date and contents. If sediment accumulates on the decontamination pad, it will be removed and added to the drums containing investigation-derived waste (IDW) soil. If the liner becomes damaged, it will be removed and replaced. The old liner will be contained as separate IDW.

Solvent rinsate will not be combined with other decontamination washwater and rinsewater. Solvent rinsate will be collected and labeled in separate containers.

2.2.5.3 **Analyte-free Water Containers** Containers used to hold analyte-free water will be constructed of glass, Teflon™, polypropylene, or high-density polyethylene (HDPE). Containers will be kept wet on the inside and capped with aluminum foil or Teflon™ film at all times.

2.2.5.4 **Cleaning Procedure for Sampling Equipment** The following procedure will be used for all field sampling equipment (e.g., split spoons, spatulas, etc.).

Equipment will be:

- washed thoroughly with laboratory detergent and hot potable water using a brush to remove any particulate matter or surface film,
- rinsed thoroughly with hot potable water,
- rinsed with a greater than 10 percent acid solution,
- rinsed thoroughly with deionized water,
- rinsed twice with solvent,
- rinsed thoroughly with analyte-free water and air dried (if analyte-free water is not available, the equipment will be air dried after the solvent rinse and will not be rinsed with deionized or distilled water), and
- wrapped in aluminum foil, dated, sealed, and placed in plastic for offsite transport.

2.2.5.5 **Cleaning Procedure for Non-sampling Equipment** Large equipment that is not directly used for sampling (e.g., drilling equipment, backhoe, etc.) will be decontaminated prior to use and between sample locations. Equipment will be inspected for fuel or lubricant leaks and to confirm that all gaskets and seals are intact. Any part of the equipment that is over the borehole or excavation (e.g., breakout table, kelly, mast, backhoe bucket, driller's stand and controls, winches, spindles, cathead, etc.) will be steam cleaned. Any hollow equipment (e.g., rods, augers, etc.) will be cleaned inside and out. The steam cleaner will be capable of generating at least 2,500 pounds per square inch (psi) of pressure, and producing hot water and steam at temperatures of at least 200 degrees Fahrenheit (°F). If necessary, equipment may also be scrubbed with detergent and potable water.

Well casings and screens will preferably be supplied new, sealed in watertight factory packaging, with documentation of manufacturers' cleaning procedures. If not, they will be steam cleaned prior to use.

2.2.6 Location Clearance ABB-ES will coordinate field activities with the Navy to prevent interfering with base operations and impacting utilities and subsurface structures. Sampling and testing locations will be cleared for utilities and subsurface structures by reviewing as-built records and by hand-augering the first 2 to 5 feet of soil prior to drilling.

2.2.7 Abandonment and Pavement Repair At most soil gas sampling, well, piezometer, and probe locations, the ground surface is paved with asphalt or with 12-inch, reinforced concrete. Coring will be performed on an ongoing, as-needed basis by the soil gas and drilling subcontractors. At the completion of sampling and testing activities, the pavement will be returned to its previous condition. The following abandonment and paving procedures will be performed.

- **After the soil gas survey**--Soil gas sampling locations will be grouted and paved by the soil gas subcontractor while supervised by ABB-ES staff. Repaired surfaces will match the existing grade and will be paved with asphalt or concrete to match the surrounding surface material.

- **After the field sampling and testing**--GE/AI wells will be permanently installed and will not be abandoned. Vapor extraction (VE) wells, piezometers, and vapor observation (VO) probes will be temporarily installed and will be abandoned. ABB-ES will cut the wells to allow the required paving. ABB-ES will then grout the wells and repair the surface. Repaired surfaces will match the existing grade and will be paved with asphalt or concrete to match the surrounding surface material.

2.3 SOIL GAS SURVEY. The soil gas survey is the first step in the field program. The survey will not be used to delineate the plume of dissolved VOCs; it will be used solely to assess the type and relative concentrations of organic vapors in the vadose zone.

2.3.1 Scope of Survey The soil gas survey will be performed to identify the highest relative concentrations of organic vapors within the two study areas. The approximate dimensions and number of soil gas probes to be used in each of these areas follows:

- **Building 106**, 100 by 200 feet with 20-foot centers, 50 soil gas probes; and

- **Building 780**, 100 by 160 feet, with 20-foot centers, 40 soil gas probes.

These study areas (see Figure 1-4 and 1-5) may be adjusted in the field if utilities and subsurface structures prevent the required clearance. The rationale for positions of these adjusted study areas will be included in the field logbooks.

The results of the soil gas survey will be used to identify the location of wells to be installed during the field program. Wells will be installed in the locations exhibiting the highest concentrations of organic vapors within the two study areas. The soil gas survey will also be used to assess the volatilization and biodegradation properties in the study areas. Relative concentrations of organic vapors will be used to estimate the type, rate, and degree of volatilization and biodegradation that may be occurring.

2.3.2 Survey Procedure The soil gas survey will be performed by a subcontractor under the direction of ABB-ES. ABB-ES will identify and mark soil gas sampling locations with wooden stakes and fluorescent paint prior to the arrival of the subcontractor.

Soil gas will be collected with soil gas probes and will be immediately injected into an onsite gas chromatograph (GC) for analyses of the following parameters:

- total VOCs,
- ethylene,
- vinyl chloride,
- 1,1-dichloroethene,
- cis-1,2-dichloroethene,
- trans-1,2-dichloroethene,
- 1,1-dichloroethane,
- trichloroethene,
- 1,1,1-trichloroethane,
- tetrachloroethene,
- chloroform,
- methylene chloride, and
- carbon tetrachloride.

The results from the GC will be used by the subcontractor to prepare contour maps of relative organic vapor concentrations. The subcontractor will include these maps in a report to ABB-ES. Soil gas data will not be entered into ABB-ES's electronic database or manipulated by ABB-ES. ABB-ES will incorporate the subcontractor's report as a stand-alone appendix to the EE/CA.

2.4 COLLECTION OF SOIL SAMPLES. Soil samples will be collected to evaluate the type of biological activity that may be occurring at OU 3. Analytical parameters for soil samples are listed in Table 2-2, and details of the analytical program are discussed in Chapter 3.0. Because the majority of biodegradation occurs in saturated soil, these samples will be collected from below the groundwater table. Two soil samples will be collected from each boring drilled for the installation of GE/AI wells:

- one sample from immediately below the groundwater table, which is approximately 5 feet below land surface (bls); and

- one sample from the bottom of the boring, which will be approximately 15 feet bls.

Table 2-2
Analytical Parameters for Soil Samples

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
Buildings 106 and 780 at Operable Unit 3
NAS Jacksonville, Jacksonville, Florida

Location of Analyses	Analytical Parameter
Analytical Laboratory	Ammonia nitrogen Nitrogen, organic and Kjeldahl Nitrite and nitrate Ortho-phosphates Sulfate (SO_4) Sulfides Total organic carbon
ABB-ES Biological Laboratory	Chlorinated VOC-degrading bacteria

Notes: ABB-ES = ABB Environmental Services.
VOC = volatile organic compound.

Continuous split-spoon samples will be collected from the boreholes drilled for the installation of GE/AI wells. These samples will be used to record geologic information in the field logbook. This information will be used to prepare a geologic log for each borehole that will include:

- stratigraphy,
- moisture content,
- readings from field monitoring equipment, and
- Unified Soil Classification System (ASTM, 1993) designation (including texture, color, consistency, layering, and other pertinent data).

When the desired sampling interval is encountered, a portion of soil within the split spoon will be removed with a steel spoon and containerized for offsite transport. Soil intended for VOC analyses will be collected from the center (interior) portion of the split spoon, placed in appropriate containers, and immediately capped. Soil intended for all other analyses will be mixed with a stainless-steel spoon in a steel or glass bowl and then placed in appropriate containers. The sample location, sampled depth, sample number, and other pertinent information will then be recorded in the field logbook.

2.5 INSTALLATION OF WELLS, PIEZOMETERS, AND PROBES. Wells will be installed to collect soil and groundwater samples and to conduct field tests; piezometers and probes will be installed to monitor the performance of the field tests. Table 2-3 summarizes the construction of each well, piezometer, and probe and Figure

2-2 presents a schematic comparison of the construction. The locations will be based on the results of the soil gas survey.

Table 2-3
Well, Piezometer, and Probe Construction Detail

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
Buildings 106 and 780 at Operable Unit 3
NAS Jacksonville, Jacksonville, Florida

Type	Construction					
	Total Depth (feet)	Screen Length (feet)	Screen Size (inch)	Well Diameter (inch)	Filter Pack	Finish
Groundwater Extraction/Air Injection (GE/AI) Well	15	5	0.010	4	Sand	Permanent concrete and bentonite.
Vapor Extraction (VE) Well	5	4	0.050	4	Pea Gravel	Temporary bentonite seal.
Piezometer	15	5	0.010	2	Sand	Temporary bentonite seal.
Vapor Observation (VO) Probe	5	1	0.020	3/4	Sand	Temporary bentonite seal.

The rationale for installing testing locations at each study area (Buildings 106 and 780) follows.

1. The GE/AI well will be installed in the area with the highest soil gas measurement(s).

2. The VE well will be installed adjacent to the GE/AI well.

3. The four piezometers will be installed at distances of 5, 10, 20, and 30 feet from the location of the GE/AI and VE wells, in a direction that is parallel to the nearest building (to minimize impacts to facility personnel and traffic).

4. The five VO probes will be installed at distances of 5, 10, 15, 25, and 35 feet from the location of the GE/AI and VE wells, in a direction that is parallel to the nearest building (to minimize impacts to facility personnel and traffic).

A corehole will be drilled through the paved ground surface at each proposed location for the installation of wells, piezometers, and probes. A shallow borehole (2 to 5 feet) will then be manually drilled with a hand auger until the field team is confident that utilities and subsurface structures are cleared. The remainder of the borehole will then be drilled with a mechanical drilling rig equipped with hollow-stem augers. The collection of soil samples during drilling activities will be performed as described in Section 2.4.

After installation the wells will be developed to remove silt and fine-grained particles from the screen and filter pack. The development method will use a surging action, inducing flow in two directions. Methods such as Brainard-Kilman hand positive-displacement pump or surge block will be acceptable. Solely pumping without achieving a surge will be unacceptable. Pumping the well dry will also be avoided.

2.5.1 Groundwater Extraction and Air Injection (GE/AI) Wells Two GE/AI wells will be installed: one at Building 106 and one at Building 780. These wells will be permanently installed with a cement and bentonite grout, flush-mounted, and capped with a steel manhole cover and concrete apron. A standard annular space is required, but it will be well sealed and essentially air tight. The sand pack around the screen will not extend more than a few inches above the screen; this is critical in reducing the potential for "short-circuiting" during the air injection test. A minimum of 6 inches will be required between the ground surface and the top of the cement and bentonite grout to allow sufficient space for testing equipment.

2.5.2 Vapor Extraction (VE) Wells Two VE wells will be temporarily installed: one at Building 106 and one at Building 780. The wells will be finished with a polyvinyl chloride (PVC) stick-up that extends approximately 6 inches above the ground surface. An increased thickness of annular space is required, that can be accomplished by overdrilling a 14-inch borehole. Pea gravel will be used in lieu of sand pack, and a geomembrane or other polymer will be placed on top of the pea gravel to allow placement of bentonite. The pea gravel will not extend below the water table; this is critical in reducing the potential for "upwelling." A bentonite seal will be used above the polymer and it will be well sealed and essentially air tight.

2.5.3 Piezometers Eight piezometers will be temporarily installed: four at Building 106 and four at Building 780. The wells will be finished with a PVC stick-up that extends approximately 6 inches above the ground surface. A standard annular space filled with bentonite to the ground surface will be used and it will be well sealed and essentially air tight.

2.5.4 Vapor Observation (VO) Probes Ten VO probes will be temporarily installed: five at Building 106 and five at Building 780. The wells will be finished with a PVC stick-up that extends approximately 6 inches above the ground surface. A standard annular space filled with bentonite will be used and it will be well sealed and essentially air tight.

2.6 COLLECTION OF GROUNDWATER SAMPLES. Prior to collecting groundwater samples, the GE/AI wells will be purged to remove stagnant water from the well, which will allow the collection of water that is representative of the aquifer formation. Purging will be accomplished by evacuating three well-volumes of groundwater from the wells to be sampled. After purging is complete, the following field measurements of the groundwater will be performed:

- pH,
- dissolved oxygen, and
- redox potential.

These measurements will be used along with the results of laboratory analyses to assess the aquifer equilibrium conditions and the type of biological activity that may be occurring. Two groundwater samples will be collected from each GE/AI well. Analytical parameters for groundwater samples are listed in Table 2-4 and details of the analytical program are discussed in Chapter 3.0.

Table 2-4
Analytical Parameters for Groundwater Samples

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
Buildings 106 and 780 at Operable Unit 3
NAS Jacksonville, Jacksonville, Florida

Location of Analyses	Analytical Parameter
Field Measurement	pH Dissolved oxygen Redox potential
Analytical Laboratory	Biochemical oxygen demand Chemical oxygen demand Iron Ammonia nitrogen Nitrogen, organic and kjeldahl Nitrite and nitrate Sulfate (SO_4) Sulfides Volatile organic compounds (VOCs)
ABB-ES Biological Laboratory	Chlorinated VOC-degrading bacteria

Notes: ABB-ES = ABB Environmental Services, Inc.

__2.6.1 Well Purging__ A well will be purged before sampling to remove stagnant water. The well will then be sampled within 1 hour of purging. Three to five times the volume of water standing in the well will be purged until field parameters (pH, temperature, and conductivity) stabilize. Field parameters will be measured after each volume is removed, or at approximately 5-minute intervals. Purging will be considered complete when any of the following is achieved:

- at least three well volumes have been purged and the parameters of temperature, pH, and conductivity in two consecutive measurements differ by no more than 5 percent;
- five well volumes have been purged; or
- the well has been pumped dry.

If possible, wells will not be pumped dry. A well volume is calculated from the height of the standing water column in the well using the following formula (or equivalent):

$$V = \pi(d/2)^2h \qquad (1)$$

where

V = well volume (cubic feet),
π = pi (3.14159),
d = inside diameter of well (feet), and
h = height of water column (depth to bottom of well minus depth to water in feet).

Whenever possible, purging will be accomplished by pump. Because of potential cross contamination with submersible pumps, vacuum lift pumps are preferred, but submersible pumps are acceptable if no other pump is available. Decontaminated Teflon™ bailers can be used when circumstances make the use of a pump difficult or excessively time consuming. Stainless-steel bailers are not to be used. Disposable equipment (e.g., pumps and bailers) will be used to bail wells that are extremely contaminated with oily compounds, because the equipment may be difficult to decontaminate.

When using vacuum lift pumps, only the intake tubing will be placed into the water column; this intake tubing will be Teflon™. When submersible pumps are used, pump construction will be of Teflon™ and stainless steel only, and the wetted parts of the pump and tubing are to be decontaminated according to Subsection 2.2.5.

Backflow of purged water into wells will be avoided. Either the pump or pump hose will be removed from the water column prior to stopping the pump. For vacuum lift pumps, a foot valve is effective; for submersible pumps, a check valve is effective.

<u>2.6.2 Well Sampling</u> Teflon™ bailers are preferred for the collection of groundwater samples. New nylon twine will be attached to the bailer via a Teflon™-coated stainless-steel wire. This wire will be attached to the bailer semipermanently and will be decontaminated for reuse with the bailer. The nylon twine will be cut so that only the bailer and new twine contact the water column.

If a bailer cannot be used (e.g., well damage prohibits a bailer from entering the well), a peristaltic pump can be connected to Teflon™ tubing placed into the water column to collect the sample. Groundwater for VOC analyses cannot be pumped through the peristaltic pump. Instead, the pump will be used to pull water into the tubing. The tubing will then be pulled from the well and groundwater will be emptied into the appropriate containers from the end of the tubing that was in the well. Samples for other analyses may be pumped through the peristaltic pump.

The following general procedure will be used for the collection of groundwater samples:

- <u>Special Procedure: Samples destined for iron analyses will be collected in pairs, one field-filtered and one unfiltered</u>.

- Sample containers destined for VOC analyses will be filled with minimal agitation. The groundwater in the bailer will be gently poured along the inside wall of the VOC vial. The container will be filled until the sample forms a convex meniscus above the top edge of the vial and then the vial cap will be carefully capped. No air headspace will be allowed in the vial. This will be checked by inverting the VOC vial and tapping it to check for air bubbles. If bubbles are present, the vial will be emptied and more sample volume will be used.

- Other sample containers will be filled and preservative added (if needed).

- Filled containers will be placed into cooler(s) and the coolers closed.

2.7 GROUNDWATER PUMPING TEST. The purpose of the pumping test is to obtain drawdown data that can be used to calculate surficial aquifer characteristics, such as hydraulic conductivity, transmissivity, and specific yield. These parameters will be used to predict the effectiveness of pump-and-treat technologies at Buildings 106 and 780. Using hydraulic conductivity values calculated from slug tests at OU 3, an estimated sustained yield of only 0.3 gallon per minute (gpm) was calculated for a 3-day pumping test. Thus, a similar yield (less than 0.5 gpm) is anticipated for the proposed 1-day pumping test.

2.7.1 Equipment and Setup Figure 2-3 presents a schematic diagram of the proposed pumping test. A peristaltic pump will be used to extract groundwater from the GE/AI wells at each study area. It is anticipated that a peristaltic pump will be the most efficient pump for low pumping rates. However, a submersible pump will also be available onsite in the event that higher pumping rates are possible.

Pressure transducers, connected to a data logger, will be lowered into each piezometer. These transducers will be used to record the drawdown in each piezometer during the pumping test.

2.7.2 Testing Procedure Based on the estimated yield, low volume pumping tests will be conducted according to the following procedure:

1. The depth to groundwater will be measured in the GE/AI well and piezometers.

2. The pressure transducers (connected to a data logger) will be lowered into the GE/AI wells and piezometers. The transducer will not be lowered to a depth beyond it's functioning capability. For example, a 6-psi transducer will not function if the water column above it is greater than 13.8 feet. The transducer will be anchored with duct tape so that it does not move during the pumping test.

3. The peristaltic pump tubing will be lowered into the GE/AI well and anchored so that the intake is at a depth above the pressure transducer.

4. The pump will be started and the pumping rate adjusted to 0.25 gpm. The drawdown in the pumping well will be monitored for 10 to 15 minutes. If a pumping rate is sustainable after this period of time, the pumping rate will be increased to 0.5 gpm. The pumping rate will continue to be increased at 0.25-gpm intervals (or greater as warranted by the drawdown data) for a period of 1 hour. Based on the drawdown data in the pumping well, a maximum pumping rate sustainable for an 8-hour pumping test (i.e., will not draw down the water level below the pump intake) will be estimated. The pump will be turned off and the water level allowed to recover to at least 90 percent of its static level.

5. The data logger will be operated in the "pre-test" mode for 30 minutes to assess the natural fluctuation in the groundwater level.

6. The pumping test will begin by simultaneously starting the pump (at the maximum sustainable pumping rate) and starting the data logger in the "test" mode. Drawdown data will be collected on a logarithmic time scale for 8 hours.

7. The pumping rate will be monitored continuously with a flow meter as drawdown increases. The pumping rate will be adjusted as necessary to maintain a constant flow.

8. If drawdown data indicate during the test that the pumping rate cannot be sustained for 8 hours, the rate will be decreased and the test continued. The time at which the rate was changed will be recorded.

9. After 8 hours of pumping, the pump will be stopped and the recovery of the groundwater table measured to at least 90 percent of its static level. The recovery will be measured on a logarithmic time scale.

2.8 VAPOR EXTRACTION TEST. The purpose of the vapor extraction test is to measure the influence of a vacuum applied to a shallow well screened in the vadose zone. The VE well will be connected to a regenerative vacuum blower to induce a vacuum in the vadose zone. Based on site geology, it is anticipated that the maximum influence (measured as vapor flow rate) will be achieved before a vacuum of 50 inches of water is achieved. As the induced vacuum approaches 50 inches, the groundwater will rise into the well screen and seal off the path of vapor flow. This process is referred to as "upwelling." It is anticipated that the maximum vapor flow rate achievable under these conditions will be less than 50 standard cubic feet per minute (SCFM).

Upwelling can be reduced or eliminated by depressing the water table. This can be accomplished by pumping groundwater from a nearby well (e.g., the adjacent GE/AI well) while performing the vapor extraction test. However, the results of each test (aquifer pumping and vapor extraction) would be compromised, and true aquifer characteristics would not be measured. Thus, the vapor extraction test will be performed after completion of the pumping test.

2.8.1 Equipment and Setup Figure 2-4 presents a schematic diagram of the proposed vapor extraction test. Five VO probes will be used to measure the influence of the vacuum applied to the VE well.

The following are major components of the testing system:

- 1.5-horsepower (HP), single phase, 220-volt, regenerative vacuum blower;
- moisture separator;
- inlet solids filter;
- inline flow meter with a range from 5 to 50 SCFM;
- multiple vacuum gauges with a range from 0 to 60 inches of water;
- dial thermometer with 4-inch stem with a range from 50 to 200 °F;
- barbed fittings and Tygon™ tubing; and
- PVC pipeline, tees, elbows, reducers, caps, and ball check valves.

The blower will be connected to the VE well with PVC pipeline as shown on Figure 2-4. The moisture separator, inlet solids filter, and inline flow meter will also be connected with PVC pipeline as shown. At each VO probe, a barbed fitting will be glued to the PVC well cap, and will be connected to a short section (approximately 2 feet) of Tygon™ tubing. Vacuum gauges will then be connected to the Tygon™ tubing and interchanged as required to measure various vacuum ranges.

2.8.2 Testing Procedure Prior to beginning the test, the water level in the GE/AI well will be recorded. Based on the estimates described above, the following test procedure will be performed.

Optimization Testing Procedure

1. The blower will be started and a vacuum of 5 inches will be achieved and maintained in the VE well for 15 minutes. The vapor flow rate and temperature will be recorded at that time.

2. The vacuum in the VE well will be increased to 10 inches and that vacuum will be maintained for 15 minutes. Vapor flow rate and temperature will be recorded at that time.

3. The vacuum will continue to be increased in 5-inch increments and the vapor flow rate and temperature will be recorded every 15 minutes until a vacuum of 50 inches is achieved.

    (a) If it appears that increasing the vacuum beyond 50 inches will result in an increased vapor flow rate, the procedure will be continued in 5-inch increments until the vapor flow rate remains constant.

    (b) If the vapor flow rate remains constant before 50 inches is achieved, the procedure will be stopped at that point.

Influence Testing Procedure

The optimum vacuum for the influence test is the minimum vacuum that was required to maximize the vapor flow rate, that is, the vacuum achieved just before the flow rate began to remain constant.

1. The blower will be started and the optimum vacuum based on the optimization test achieved. This vacuum will be maintained throughout the influence test.

2. The initial vapor flow rate and temperature in the VE well and the vapor flow rate in the VO probes will be recorded. Measurements will be recorded every 15 minutes for 1 hour, every 30 minutes for 1 hour, and every hour for an additional 2 hours.

2.9 AIR INJECTION TEST. The purpose of the air injection test is to measure the influence of air pressure jetted into to a shallow well screened below the groundwater table. An air compressor will be connected to the GE/AI well to inject air into the groundwater. Based on site hydrogeology, it is anticipated that a maximum injection pressure of 6 psi can be achieved before pneumatic fracturing of soil occurs. When fracturing occurs, the soil "cracks," and subsurface air flows only through channels created by the cracks. This is often referred to as "short-circuiting," because the leak can occur through either the natural formation or through well construction materials (i.e., bentonite seal or grout). If fracturing occurs, only soil within the channels is in contact with the injected air and, as a result, the effectiveness of air injection is greatly reduced.

It is further anticipated that the maximum air flow achievable with an operating pressure of less than 6 psi is less than 10 SCFM. Additionally, calculations based on these estimates indicate that if the air flow is less than 0.5 SCFM at a pressure of 6 psi, air injection may be ineffective in enhancing the volatilization of chlorinated VOCs. However, this is only a theoretical estimate. These estimated pressures and flow rates are intended only to aid in performing the field test; the potential effectiveness of air sparging will be based on the actual field test data.

2.9.1 Equipment and Setup Figure 2-5 presents a schematic diagram of the proposed air injection test. Five VO probes will be used to measure the extent of increased pressure and four piezometers will be used to measure the extent of increased dissolved oxygen concentrations. The following are major components of the testing system:

- 1.5-HP, single phase, 220-volt, oil-less air compressor;
- inline flow meter with a range of 0.33 to 3.33 SCFM;
- multiple vacuum gauges ranging from 0 to 200 inches of water;
- dial thermometer with 4-inch stem ranging from 50 to 200°F;
- pressure relief valves; and
- PVC pipeline, tees, elbows, reducers, caps, and ball check valves.

The air compressor (also referred to as a rotary vane pump for this application) will be connected to the GE/AI well with PVC pipeline, as shown on Figure 2-5. The pressure relief valves and inline flow meter will also be connected with PVC pipeline, as shown. No equipment will be permanently connected to either the VO probes or the piezometers for this test. Because of the short duration of the test, the air temperature will not be high enough to damage the PVC. Literature indicates that PVC can withstand temperatures of less than 140 °F.

2.9.2 Testing Procedures Prior to beginning the test, the water level in the GE/AI well will be recorded. Based on the estimates described above, the following test procedures will be performed.

Optimization Testing Procedure

1. The air compressor will be started and a pressure of 0.5 psi will be achieved and maintained in the GE/AI well for 15 minutes. The air flow rate and temperature will be recorded at that time.

2. The pressure in the GE/AI well will be increased to 1 psi and maintained at that pressure for 15 minutes. The air flow rate and temperature will be recorded at that time.

3. Increased pressure will continue in 0.5-psi increments and the air flow rate and temperature will be recorded every 15 minutes until a pressure of 6 psi is achieved. If a pressure of 6 psi yields no air flow, pressure will continue to be incrementally increased until a measurable air flow is observed.

(a) If increasing the pressure beyond 6 psi results in no increase in the air flow rate, the procedure will be stopped at that point. THE PRESSURE WILL BE NOT BE INCREASED TO INDUCE FRACTURING.

(b) If the air flow rate suddenly increases before 6 psi is achieved, the procedure will be stopped at that point. Fracturing or short-circuiting may have occurred.

Influence Testing Procedure

The optimum pressure for the influence test is the minimum pressure that was required to maximize the air flow rate before fracturing occurred or the air flow rate remained constant.

1. The air compressor will be started to achieve the optimum pressure based on the optimization test. This pressure will be maintained throughout the influence test.

2. The initial air flow rate and temperature in the VE well, the dissolved oxygen concentration and redox potential in the piezometers, and the pressure in the VO wells will be recorded. These same measurements will be recorded every 15 minutes for 1 hour, every 30 minutes for 1 hour, and every hour for an additional 2 hours.

3.0 ANALYTICAL PROGRAM

Soil and groundwater samples will be collected during the field program, as described in Chapter 2.0. These samples will be transported to the following locations:

- analytical laboratory, approved by Naval Energy and Environmental Support Activity (NEESA), for analyses of standard physical, chemical, and biological parameters; and

- ABB-ES Wakefield office for microorganism evaluation.

3.1 Laboratory Analyses. In addition to the four soil and two groundwater samples described in Chapter 2.0, one duplicate sample of each matrix will be collected. The duplicate soil sample will be collected from the bottom of the GE/AI borehole at Building 780, and the duplicate groundwater sample will be collected from the GE/AI well at Building 106.

Samples will be transported to the analytical laboratory for a 7-day turnaround time. Tables 3-1 and 3-2 list the matrix, holding time, container, preservative, minimum sample size, number of samples, and analytical method for each analytical parameter. Because high dissolved iron concentrations can inhibit biological activity and can impede the effectiveness of certain treatment technologies, it is important to differentiate between total and dissolved iron concentrations. Thus, both field-filtered and unfiltered groundwater samples will be transported to the laboratory for iron analysis.

Samples collected during this field program are intended to estimate parameters associated with biological activity, not to quantify exact contaminant concentrations. Thus, strict QA/QC procedures and data validation are not required. Equipment, field, and trip blanks will not be collected, and matrix spike and matrix spike duplicate samples will not be requested.

3.2 MICROORGANISM EVALUATION. Screening tests will be conducted to determine the presence of naturally occurring (or indigenous) microorganisms that degrade chlorinated VOCs in the saturated subsurface. "Enrichment" procedures will be used to isolate two types of chlorine-degrading microorganisms (herein referred to as bacteria): anaerobic methanogens and aerobic methanotrophs.

3.2.1 Anaerobic Methanogen Enrichments Anaerobic bacteria are capable of dechlorinating aliphatic compounds, such as tetrachloroethene and trichloroethene. The end-product resulting from the dechlorination of aliphatic alkenes is vinyl chloride. Reduced (oxygen-deficient) conditions must be achieved for this type of dechlorination to occur.

To maintain anaerobic conditions, approximately 100 mg/ℓ of glucose will be added to the groundwater samples in the field. After receipt of samples by the ABB-ES Wakefield office, approximately 2 to 5 grams of saturated soil will be mixed with approximately 10 ml of groundwater, and placed in 160-ml glass, serum bottles. The bottles will then be capped with air-tight crimp tops. These mixtures (or cultures) will be amended with mineral nutrients and an electron donor, such as

Table 3-1
Groundwater Sample Containers, Preservative, and Analysis

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
Buildings 106 and 780 at Operable Unit 3
NAS Jacksonville, Jacksonville, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size (milliliters)	Number of Samples	USEPA Analytical Method
Biochemical oxygen demand	Water	48 hours	Polyethylene or glass bottle	4°C	1,000	3	Method 405.1
Chemical oxygen demand	Water	28 days	Polyethylene or glass bottle	pH <2.0 with H_2SO_4, 4 °C	1,000	3	Method 410.4
Iron	Water	6 months	Polyethylene or glass bottle	pH <2.0 with HNO_3, 4 °C	100	6	Method 236.2
Ammonia-nitrogen	Water	28 days	Polyethylene or glass bottle	pH <2.0 with H_2SO_4, 4 °C	400	3	Method 350.2
Nitrogen, organic and Kjeldahl	Water	28 days	Polyethylene or glass bottle	pH <2.0 with H_2SO_4, 4 °C	500	3	Method 351.3
Nitrate and nitrite	Water	28 days	Polyethylene or glass bottle	pH <2.0 with H_2SO_4, 4 °C	125	3	Method 353.1
Sulfate (SO_4)	Water	28 days	Polyethylene or glass bottle	4 °C	125	3	Method 375.4
Sulfides	Water	7 days	Polyethylene or glass bottle	pH >9.0 with zinc acetate and NaOH, 4 °C	500	3	Method 376.1
Volatile organic compounds	Water	10 days	Polyethylene or glass bottle	1:1 HCl, 4 °C	40	3	Method 8240

Notes: USEPA = U.S. Environmental Protection Agency.
°C = degrees Celsius.
H_2SO_4 = sulfuric acid.
HNO_3 = nitric acid.
NaOH = sodium hydroxide.
HCl = hydrochloric acid.

Table 3-2
Soil Sample Containers, Preservative, and Analysis

Interim Removal Action Technology Evaluation
Field Sampling and Analysis Plan
Buildings 106 and 780 at Operable Unit 3
NAS Jacksonville, Jacksonville, Florida

Parameter	Matrix	Holding Time (from time of collection)	Container	Preservative	Minimum Sample Size	Number of Samples	USEPA Analytical Method
Ammonia-Nitrogen	Soil	28 days	Polyethylene or glass bottle	4 °C	400 ml	5	Method 350.2-M
Nitrogen, organic and Kjeldahl	Soil	28 days	Polyethylene or glass bottle	4 °C	500 ml	5	Method 351.3-M
Nitrate and nitrite	Soil	28 days	Polyethylene or glass bottle	4 °C	125 ml	5	Method 353.1-M
ortho-phosphates	Soil	48 hours	Polyethylene or glass bottle	4 °C	50 ml	5	Method 365.3-M
pH	Soil	------	--------	4 °C	------	5	Method 150.1
Sulfate, SO_4	Soil	28 days	Polyethylene or glass bottle	4 °C	125 ml	5	Method 375.4-M
Sulfides	Soil	7 days	Polyethylene or glass bottle	4 °C	500 ml	5	Method 376.1-M
Total organic carbon	Soil	28 days	Polyethylene or glass bottle	4 °C	10 g	5	Method 9060

Notes: USEPA = U.S. Environmental Protection Agency.
°C = degrees Celsius.
ml = milliliter.
g = gram.

methanol or lactate. Resazurin, which is used as an indicator of reduced conditions, will also be added. The cultures will then be incubated at 35 °C.

Methane production (methanogenesis) occurs as a result of methanogenic bacterial activity. The headspace in the sample containers will be analyzed for methane with a laboratory GC. Once methanogenesis has been established, dechlorination testing will be conducted. Tetrachloroethene or trichloroethene will be added to the cultures. Dechlorination will then be measured by analyzing the samples (either headspace or aqueous phase) for the presence of transformation products, such as dichloroethene or vinyl chloride. Production of these compounds will indicate that anaerobic chlorine-degrading bacteria are present in the samples.

<u>3.2.2 Aerobic Methanotroph Enrichments</u> Methanotrophic bacteria are aerobic organisms that use methane as a source of carbon. The bacterial enzyme that is responsible for oxidizing methane is also capable of oxidizing chlorinated aliphatic compounds such as dichloroethene and vinyl chloride. The end-product resulting from the dechlorination of vinyl chloride is ethene.

To prevent artificial aeration during sample collection, approximately 100 mg/ℓ of glucose will be added to the groundwater samples in the field. After receipt of samples by the ABB-ES Wakefield office, approximately 2 to 5 grams of saturated soil will be mixed with approximately 10 mℓ of groundwater, and placed in 160-ml glass, serum bottles. The bottles will then be capped with air-tight crimp tops. Methane will then be injected into the headspace of the bottles. The bottles will then be incubated at approximately 20 °C, while shaken for 24 to 48 hours. A portion of the culture will be transferred into a test vessel that contains mineral salts and methane. This culture will be allowed to incubate for an additional 3 to 5 days. Turbidity in the culture will be used as an indicator of bacterial growth. The procedure will be repeated as needed on a weekly basis to maintain methanotrophic cultures.

After the required incubation, 5 ml of the culture will be placed into 45 ml of mineral salts. Additional methane will be injected as a source of carbon, and approximately 200 μg/ℓ of dichloroethene will be added. After further incubation, a portion of the culture will be removed for analysis of dichloroethene and a transitional biodegradation product (dichloroethene epoxide) by USEPA Method 8010 (modified). Specific changes in the concentrations of these compounds will indicate that aerobic chlorine-degrading bacteria are present in the samples.

<u>3.2.3 Methane and Ethene Analysis</u> Upon receipt of the samples at the ABB-ES Wakefield office, vapor from the headspace within the groundwater sample containers will analyzed for methane and ethene with a laboratory GC. Relative concentrations of these compounds will be used to further evaluate the type of bacteria that are present in the subsurface.

<u>3.2.4 Sample Requirements</u> Samples collected for microorganism evaluation will be packaged as described below. These samples will be packed with ice to maintain a temperature of no more than 4 °C, and will be transported to the ABB-ES Wakefield office. Pre-preserved 500-ml bottles containing glucose will be provided by the ABB-ES Wakefield office; the remaining sample containers do not require preservative (other than ice), and will be supplied by the ABB-ES field team.

Groundwater

four 500-ml bottles for each GE/AI well, preserved with glucose, no headspace (two for anaerobic enrichment tests and two for aerobic enrichment tests)

three 40-ml VOA vials for each GE/AI well, no headspace (three for methane and ethylene analysis)

Soil

one 4-ounce jar for each sample depth from each GE/AI well, no headspace (one for both anaerobic and aerobic enrichment tests)

4.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTES (IDW)

IDW will be generated during the field program. IDW will be contained by ABB-ES and staged at an area designated by the Navy. The types of IDW anticipated and the proposed characterization are described in the following sections.

4.1 TYPES OF IDW. The types of IDW anticipated to be generated during the field program are listed below. IDW will be segregated by location (Building 106 or Building 780) and type (listed below):

- soil,
- groundwater and aqueous decontamination fluid (water),
- nonaqueous decontamination fluid (organic solvent), and
- PPE and other disposable equipment.

If localized "hot spots" are identified by field observations, IDW can be further segregated within each category.

4.1.1 Soil. Excess soil will be produced from drilling activities. This solid IDW will be contained in 55-gallon drums, which will be supplied by the drilling subcontractor. Sealed drums will be transferred to a staging area designated by the Navy.

4.1.2 Groundwater and Aqueous Decontamination Fluid. Groundwater will be generated during well development, purging, and the pumping test; aqueous decontamination fluid will be generated during decontamination activities. This liquid IDW will be contained in 55-gallon drums. Drums for well development water will be supplied by the drilling subcontractor; drums for purge water, pump-test water, and aqueous decontamination fluid will be supplied by the Navy. Sealed drums will be transported to a staging area designated by the Navy. The Navy may transfer liquid IDW from these drums into an onsite holding tank, if desired. However, this transfer should be performed only if the newly generated IDW will not change the regulatory classification of the existing liquid within the tank.

4.1.3 Nonaqueous Decontamination Fluid. Isopropanol and other organic solvents will be generated when decontaminating equipment. This nonaqueous liquid IDW will be contained separately from other liquid IDW (i.e., groundwater and aqueous decontamination fluid). It is anticipated that 55-gallon drums will not be required because of the small volume of organic solvents expected to be used. Thus, solvent rinsate will be stored in 5-gallon pails. If offsite transport is required, the Navy should transfer the solvent rinsate into Department of Transportation (DOT)-approved shipping containers.

4.1.4 Personal Protective Equipment and Other Disposable Equipment. PPE and other disposable equipment may include any of the materials listed below. These materials will be double-bagged in heavy-duty trash bags and disposed as non-hazardous, municipal solid waste:

- PPE, such as disposable work gloves, coveralls, and overboots;
- health and safety equipment, such as respirator cartridges;
- disposable sampling, testing, and decontamination equipment; and
- miscellaneous supplies, such as paper towels and twine.

4.2 REQUIRED LABELING AND CHARACTERIZATION. Staged drums will be labeled with the following information:

- site location (Building 106 or Building 780),
- sampling location (OU3MW001, OU3VO006, etc.),
- matrix (soil or water), and
- date generated (month, day, and year).

Based on the small volume of IDW anticipated, two composite samples from each matrix at each location will be sufficient. This produces four samples from "soil" IDW and four samples from "groundwater and aqueous decontamination fluid" IDW.

The Navy does not intend to classify IDW generated from the proposed study area as "listed hazardous waste." Thus, the IDW can be classified as either a "characteristic hazardous waste" or a "non-hazardous waste." The analyses listed below will be performed to determine the appropriate classification:

- TCLP metals (SW-846),
- TCLP volatiles (SW-846),
- TCLP semivolatiles (SW-846),
- ignitability (40 Code of Federal Regulations [CFR] 261.21),
- corrosivity (SW-846), and
- reactivity (SW-846).

Upon receipt of the analyses, the Navy's Installation Restoration (IR) Coordinator will classify the IDW and notify the Navy's Public Works Center (PWC) to dispose of the IDW.

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